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Browsed Plant Method for Young Quaking Aspen

An Annual Monitoring Method for Determining the Incidence of Use on Sprouts and Young Plants During the Growing Season

Acknowledgements

This guide has been written using the layout and process found in Interagency Techincal Reference 1734-3, Utilization Studies and Residual Measurements. Use of this guide is intended as a supplement to TR 1743-3. An understanding of TR-1743 is recommended to skillfully measure plant herbivory.

The title phrase "Incidence of Use on Sprouts and Young" has been borrowed from the University of Idaho Stubble Height Study Report, which is suggested reading for managers of riparian herbaceous vegetation. It is important for the reader to understand the distinction between incidence of use, degree of use, and herbaceous stubble height as well as how these measures interrelate and the appropriate application of each measurement.

Our gratitude is given to Dr. Richard Keigley, Ecologist with U.S. Geological Survey and Michael Frisina, Range Coordinator with Montana State Fish, Wildlife and Parks, for use of their illustrations and descriptions of tree and shrub stem production and architectural forms caused by browsing. The Montana FWP series on evaluation and management of browse is suggested reading for managers of riparian woody vegetation.

Special thanks are given to David Burton, Lead Investigator to the Aspen Delineation Project in the Sierra Nevada, Southern Cascades and Great Basin. David's vision, enthusiasm and optimism have spurred all of us involved in this fantastic project to take the next step of restoring aspen communities across the landscapes we help manage.

Fred's Place

Cover Photo by Fred Kent, Jr. (1946-2004)
Kyburz Fork on Payen Allotment
Sierraville Ranger District
Tahoe National Forest, California

Browsed Plant Method for Young Quaking Aspen

The Browsed Plant Method has been developed to assess level of herbivory occurring on young and sprouting aspens. The method is used to gather data on the percentage of young plants browsed in a delineated stand of cohorts and the degree to which the population, as a whole, has *interrupted* or *arrested growth* (Keigley and Frisina 1998). The Grazed Plant Method (Roach, 1950; Hurd and Kissinger 1953; US Forest Service, 1993) is a similar approach used on key bunch grass species. The objective is to determine the incidence of use on terminal leaders of the primary stems of aspen sprouts and young trees, less than or equal to five feet in height, during or at the end of the current growing season. Incidence of use is calculated from a count of individual young aspen plants that have terminal buds either intact or removed. Unlike the Grazed Plant Method, there are no correlations made between the browse count and percentage of use by weight.

a. Areas of Use. Locations to monitor are chosen based on critical area/key area concept as found in the interagency technical references: *Utilization Studies and Residual Measurements* (1996a) and *Sampling Vegetative Attributes* (1996b). Individual aspen stands often have unique or potentially unique biodiversity characteristics (Dobkin, Rich, Pretare, and Pyle 1995). It is appropriate to refer to individual aspen stands as *critical areas* if special management consideration is needed because of these biodiversity characteristics. An individual stand can also be described, as a *key area* where the stand is a representative sample of a larger stratum of aspen stands at the pasture, herd unit, watershed, or landscape level.

Desirable sampling locations will best quantify browsing intensity of a particular management practice at a particular time (implementation or short-term monitoring). These sites can also be used for effectiveness or long-term monitoring to establish whether a given management practice is moving a stand toward or away from a desired condition. The Browsed Plant Method, as described herein, designates quaking aspen (*Populus tremuloides*) as the *key species* being monitored. Observations are made on aspen sprouts (syn. suckers, ramets) and young aspen plants. These two age classes are the *key plants* (syn. key management species) being monitored. Available key plants in aspen stands may be very abundant or may have very limited abundance or spatial distribution. These considerations of relative abundance and distributions must be carefully considered during establishment of the monitoring site(s).

b. Advantages and Disadvantages. The Browsed Plant method is simple and quick. Recorded observations are limited to presence or absence of terminal leaders on available sprouts and young plants. Therefore, detection of terminal leader "presence or absence" is reasonably consistent between observers when rules for a positive detection of browsing are followed. The method does not make an effort to calculate utilization by percent weight of biomass or lateral branches removed. There can be considerable variation among observers if not trained to identify current year's growth, past year's growth, terminal leaders and lateral branches. It takes a trained eye to identify the terminal leader on a "medusa" shaped plant that exhibits an arrested or retrogressive architecture as described by Keigley and Frisina (1998). As noted in the Interagency Technical Reference (USDI 1996a), growth characteristics, weather conditions, and site conditions may have equal or greater influence on the appearance of plants than leader use.

c. Equipment

- √ Steel post(s) and post driver
- √ Rebar benchmark stakes
- √ Aluminum survey identification tag(s)
- √ Digital camera or 35-mm film camera with 28-mm wide angle lens
- √ Distance measuring pole, three foot length, one-half foot increments, blunted ends
- √ Height measuring staff, six foot length, one-foot increments, pointed base & blunt top
- √ Compass and Globle Positioning System (GPS) receiver

d. Training. The examiner must be skilled in recognizing current and previous year's growth to accurately identify browsed stems and count the incidence of use at the present time. Inflated and erroneous incidental use values will result if the examiner counts previous year's browse of terminal leaders, current year's browse of lateral branches, or defoliation from other environmental stressors. The trained eye can quickly identify a history and relative intensity of browsing at the key area from the architectural structure of individual plants and their cohorts. Keigley and Frisina (1998) describe four growth responses that trees and shrubs can take from repeated herbivory at various intensity levels over multiple years: (1) uninterrupted growth; (2) arrested growth; (3) retrogressed growth; and (4) released growth. When terminal leaders are removed, subordinate lateral branches will assume dominance that year or in subsequent years.

Prior to any recording of browse count, quickly examine the individual tree being sampled. Look for terminal buds, lateral buds and growth rings. Identify growth segments and dead bark below the point where stems have been clipped. Distinguish between current and previous year's growth as shown in Illustration 1. Determine which stem is the dominant terminal leader and whether or not that terminal leader has been browsed.

A number of other environment stressors can cause defoliation. Drought conditions, extensive high temperature days, insect herbivores, and pathogens are all contributing factors to defoliation. Defoliated key plants are not subject to a browse count unless the terminal leader clearly shows sign of browsing by ungulates.

e. Establishing Studies. Establish transects as shown in Illustration 2 for aspen stands, which have sparse plant distribution and/or small clumps. Establish transects as shown in Illustration 3 for aspen stands, which are large and uniform enough to place a baseline with perpendicular sampling transects. Mark the starting point (benchmark) with a steel post and aluminum survey tag. Record the azimuth of the transect line on the data entry form. Establish and record the benchmark coordinates using the GPS receiver. Mark each transect start point and record the azimuth to allow for future return monitoring. Place transects randomly as described in the Interagency Technical References for *Selecting Random Samples* (USDI 1996a, 1996b). For Stratified Random Sampling, use the Linear Transect Technique and randomly select the transect direction within the measured degree of arc for the clump that is being monitored. For Restricted Random Sampling, use the Baseline Technique and randomly select each transect starting locations perpendicular to the baseline. The baseline can be placed either through the center of the stand or along the edge of the stand.

Stratified Random Sampling (Illustration 2). This sampling approach works best when:

1. Small stands are sparse or have clumped distributions → Stratified Random Sampling
2. Large stands are sparse or clumped distribution → Stratified Random Sampling
3. There is a mix of small and large clumps → Stratified Random Sampling

Delineate and number all the clumps and then randomly select thee clumps to establish transects.

Restricted Random Sampling (Illustration 3). This sampling approach works best when:

1. Large stands with uniform distribution → Restricted Random Sampling.
2. Small stands with uniform distribution → Restricted Random Sampling.

Establish a baseline through the center or along the edge of the stand. Evenly divide the stand into equal sized sample plots. Place each transect is randomly within the associated sample plot, perpendicular to the baseline.

f. Sampling Process. The transect Schematic for *Selecting the Nearest Plant* (USDI 1996a) is used to determine which individual key plants to sample along the paced transect (see Illustration 4). Thirty observations per transect are made and recorded on the *Browse Plant Method* form (Illustration 5). A total sample of 90 observations is recommended. Adjust the sampling interval distance to assure that 30 observations can be made within each delineated sample plot. Record the sampling interval on the *Study Location and Documentation Data* form (USDI 1996a). Start transect by taking 2 paces in the direction of the identified landmark. At each sample interval, identify and record the condition of the nearest key plant within three feet using the Distance Pole and a 180-degree selection zone in front of your lead boot. If the terminal leader of the primary stem has been removed then the sampled plant is counted and the "Browse" column is checked on the *Browsed Plant Method* form (Illustration 6). If the terminal leader of the primary stem is intact then the sampled plant is counted and the "Browse" column is left blank on the form (Illustration 6). If clumped sprouts are present, record the stem nearest to the front of your boot. Use a 3-foot measuring pole to assist in determining the nearest stem. If no key plants are within the 3-foot sample zone, take two additional steps or paces and repeat the process.

(1) Additional Data. To assess ungulate browsing behavior and aspen preference, record Animal Class, Animal Type, Number of Animals, Date Animals Introduced, and Date Animals Removed. Make similar estimates for wildlife use days to the extent practical.

(2) Photo Documentation. Establish a photo point at the starting point of each transect using the guidelines provided in the Interagency Technical Guide (USDI 1996a). Take the photo from the starting point looking towards the skyline landmark. Place the Height Measuring Staff in the center of each photo at a distance of two paces. The *Photo Identification Label* is held in the immediate foreground (within one pace) and lower corner of the frame. Label the photograph with survey date, key area name, and transect number. Use large handprint, which will be legible when digitized images are downloaded or when film images are developed.

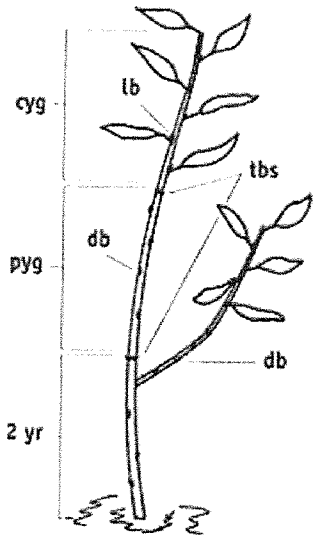
g. Calculations. The percent incidence of use on key plants will equal the number of plants browsed divided by the total number of plants observed, multiplied by 100. Table 1 and Figure 1 can be used to determine the most appropriate sample size. The example given (Illustration 6) is based on estimates for 20% incidence of use.

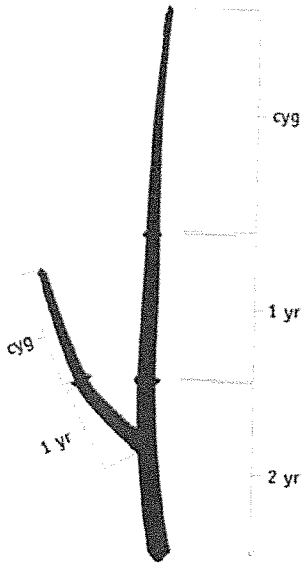
h. Data Analysis. Table 1 and Figure 1 show a 95% level of confidence that Incidence of Use estimates are within $\pm 10\%$ of the estimated true value of 20% Incidence of Use on key plants (aspen plants ≤ 5 feet in height). The upper and lower confidence interval of $n = 90$ meets these objectives (three transects of $n = 30$). This assumes the 20% estimate was achieved by sampling a number of these aspens and recording whether the terminal leader of each primary stems observed was either intact or removed. This type of yes/no data collection is binomial in nature and allows for estimates of confidence intervals based on only the initial estimate (example given here @ 20 percent use). The calculation used confidence intervals for a binomial distribution as described by Zar (1996).

Illustration 1 Sequenced Stem Production[1]

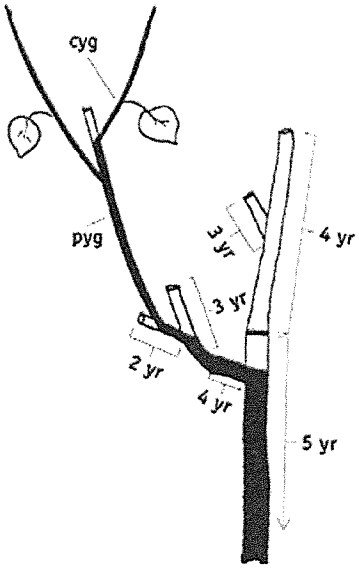
Buds form at the base of leaves. Each bud is an embryonic stem. Once a stem elongates during a growing season, no further elongation will occur In later years, but girth will be added each year in the form of annual rings. In year 2, the miniature stem within the terminal bud elongates and its leaves expand. A terminal bud scar "ring" marks the position of the terminal bud from which the second year's growth developed. For aspen there is typically a single annual growth cycle. Evidence of same year's growth is the presence of a leaf-bearing lateral branch that developed from a segment that also bears leaves.

Current year's growth = cyg
Dormant bud = db
Lateral bud = lb
Previous year's growth = pyg
Terminal bud = tb
Terminal bud scar = tbs





Uninterrupted Growth Type



Arrested, Retrogressive, or Released Growth Type

[1] Reproduced courtesy of Keigley and Frisina (1998)

Table 1 Confidence limits of 95% around and estimate of 20% incidence of use for different sample sizes.

Number of sampling units (aspens < 1.5 m)	Lower confidence limit	Upper confidence limit
30	0.077	0.386
40	0.09	0.357
50	0.1	0.338
60	0.107	0.324
70	0.113	0.313
80	0.118	0.305
90	***0.123***	***0.298***
100	0.126	0.292
150	0.139	0.274
200	0.146	0.263
500	0.165	0.238
1000	0.175	0.227

Figure 1 displays these confidence intervals graphically. Note that the confidence intervals are asymmetrical. This will always be the case when using the exact method unless the estimate is near 50 percent.

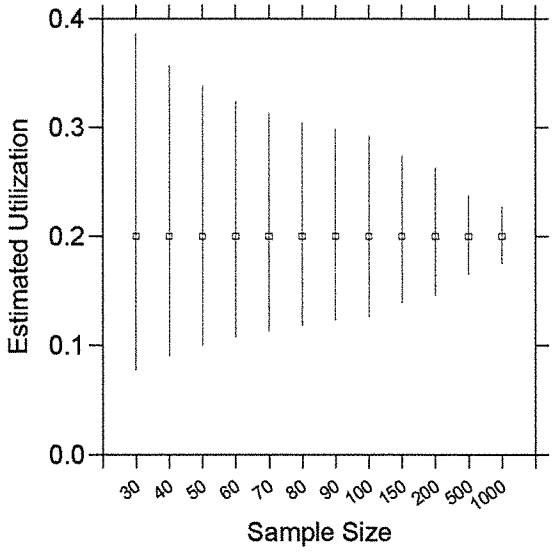


Figure 1 Confidence intervals of 95% around an estimate of 20% incidence of use.

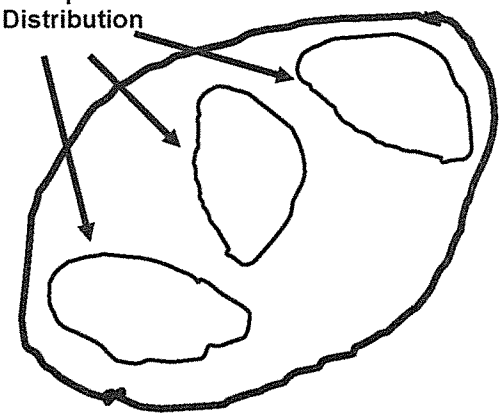
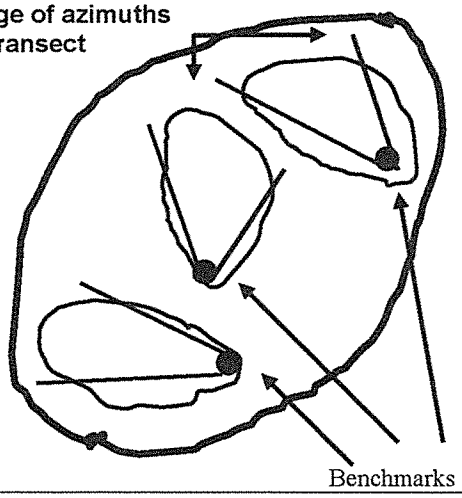
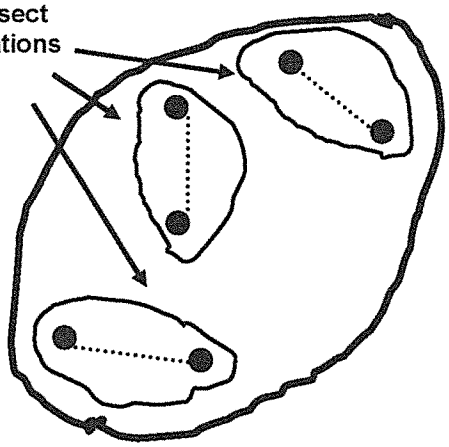
Clumped Plant Distribution 	(1) This sampling layout is used when plant distribution (≤5 ft) is sparse or clumped.
Range of azimuths for transect  Benchmarks	(2) Chose a benchmark at one end of clumped distribution of plants. (3) Set a benchmark post at that point. (4) Identify the degree of arc where transects could occur within the delineated clump. (5) For each transect randomly choose an azimuth within each degree of arc.
Transect Locations 	(6) Paced transects: Identify a skyline landmark at least 200 feet from the benchmark in the direction of the azimuth, and using the "Nearest Plant" technique (Illustration 3), walk each set of paces in the direction of the landmark.

Illustration 2 Stratified Random Sampling Protocol.

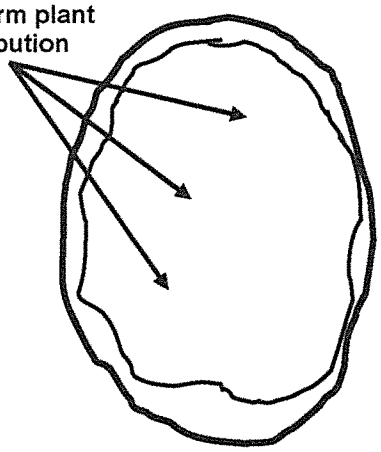
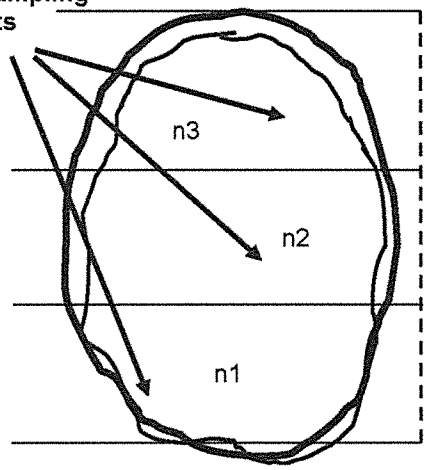
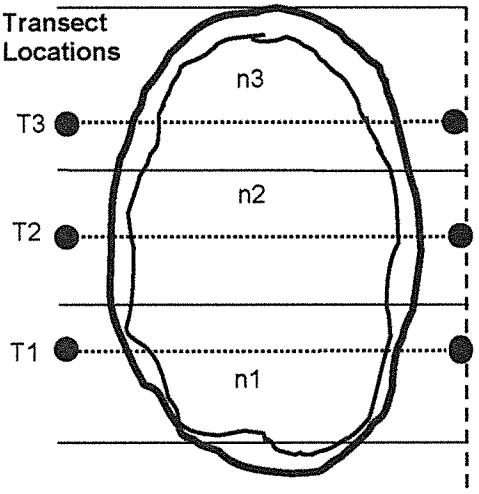
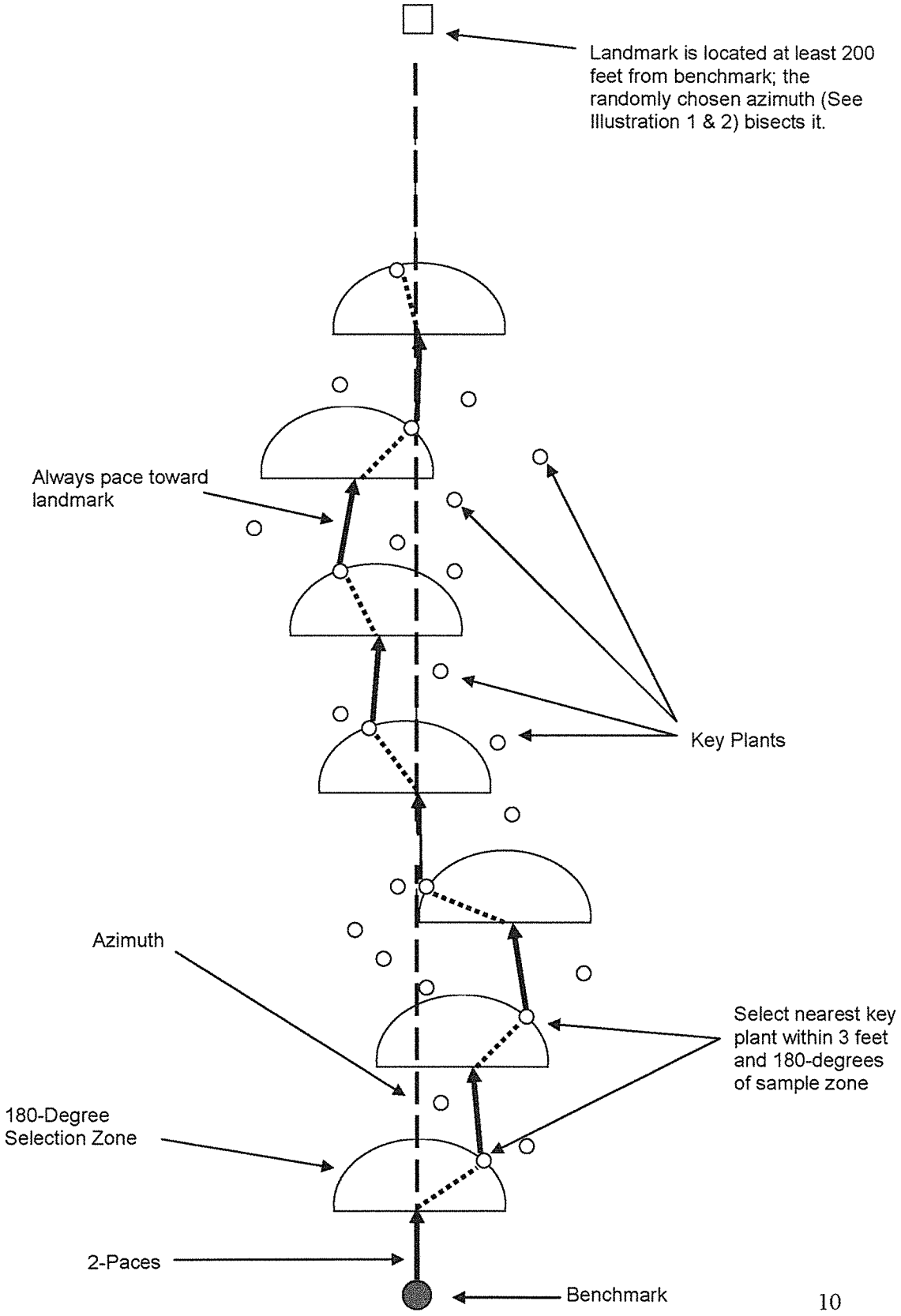
Uniform plant distribution 	(1) This sampling layout is used when young plant distribution is uniform (<5 ft between plants) and the stand is large enough to place a baseline with perpendicular sampling transects.
***n* sampling units** 	(2) Establish a baseline parallel to the stand. (3) Determine the number of sampling units, *n*. *n* = 3 in this illustration. (4) Divide the stand into *n* equal-sized segments
Transect Locations 	(5) Establish paced transects by randomly locating them within each sampling unit off the baseline. Benchmark the beginning of the sampling line. Identify a skyline landmark (at least 200 feet away) in the direction of the sampling line. Use the "Nearest Plant" technique (Illustration 3) to collect data.

Illustration 3 Restricted Random Sampling Protocol.

Illustration 4 Nearest Plant Technique for Sampling Young Aspen.



Browsed Plant Method

Sampling Date: _____ Examiner: _____

Allotment Name: _____ Recorder: _____

Key Area Name: _____ Landmark Description: _____

BM Coordinates T1: _____ Azimuth T1: _____

BM Coordinates T2: _____ Azimuth T2: _____

BM Coordinates T3: _____ Azimuth T3: _____

Animal Kind/Class: _____ Date Animals Introduced: _____

Number of Animals: _____ Date Animals Removed: _____

Transect 1				Transect 2				Transect 3			
Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse	
1		16		31		46		61		76	
2		17		32		47		62		77	
3		18		33		48		63		78	
4		19		34		49		64		79	
5		20		35		50		65		80	
6		21		36		51		66		81	
7		22		37		52		67		82	
8		23		38		53		68		83	
9		24		39		54		69		84	
10		25		40		55		70		85	
11		26		41		56		71		86	
12		27		42		57		72		87	
13		28		43		58		73		88	
14		29		44		59		74		89	
15		30		45		60		75		90	
Subtotal				**Subtotal**				**Subtotal**			

Total Browsed _____ /	**Total Sampled _____ X 100 =**	**_____ % Total Browse**

(Total No. Plants Browsed) / (Total N0. Plants Sampled) = Total % Browse for All Sampled Plants

Notes (use other side or another page, if necessary)

Illustration 5

Browsed Plant Method

Sampling Date:	09-17-04	Examiner:	Frolli
Allotment Name:	Collins	Recorder:	McProud
Key Area Name:	Wayne Spring	Landmark Description:	Morgan Mtn
BM Coordinates T1:	121° 30' 03"W 40° 22' 30"N	Azimuth T1:	56° NNE
BM Coordinates T2:	121° 29' 56"W 40° 22' 15"N	Azimuth T2:	110° SSE
BM Coordinates T3:	121° 29' 49"W 40° 21' 54"N	Azimuth T3:	220° SSW
Animal Kind/Class:	Cattle C/C	Date Animals Introduced:	09-16-03
Number of Animals:	100 pair	Date Animals Removed:	09-30-03

Transect 1				Transect 2				Transect 3			
Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse		Plot/Browse	
1	√	16		31		46		61	√	76	
2		17		32		47	√	62		77	
3		18	√	33		48		63		78	
4		19		34	√	49		64		79	√
5		20		35		50		65		80	
6	√	21		36		51	√	66		81	
7		22		37		52	√	67		82	
8		23		38	√	53		68		83	√
9	√	24		39		54		69		84	√
10	√	25		40		55		70	√	85	
11		26		41		56		71		86	
12		27		42		57	√	72		87	
13		28		43		58		73	√	88	
14		29		44		59		74		89	
15		30		45		60		75	√	90	
Subtotal		5		Subtotal		6		Subtotal		7	

Total Browsed 18 / **Total Sampled** 90 **X 100 =** 20 **% Total Browse**

(Total No. Plants Browsed) / (Total N0. Plants Sampled) = Total % Browse for All Sampled Plants

Notes (use other side or another page, if necessary)

Illustration 6

i. Glossary of Terms

[2]Arrested growth type – Architectural structure of a young plant caused by an intense level of browsing throughout its life. Browsing kills complete annual segments. Current year's growth develops from lateral stems. The plant takes on a shrub appearance.

[3]Critical Area – An area which must be treated with special consideration because of inherent site factors, size, location, conditions, values, or significant potential conflicts among users.

[2]Current Year's Growth – The most recently produced segment of elongated stems in plants during the current growing season.

[3]Degree of Use – The portion of current year's forage production that is consumed or destroyed by grazing animals.

[4]Incidence (plural of incident) – The occurrence, rate or frequency of something undesirable; to fall on or strike something.

[3]Key Area – A relative small portion of a range selected because of its location, use or grazing value as a monitoring point for grazing use. It is assumed that key areas, if properly selected, will reflect the overall acceptability of current grazing management over the range.

[3]Key Plants – (Syn. Key Management Species) Plant species on which management of a specific unit is based.

[3]Key Species – Those species which must, because of their importance, be considered in the management program.

[1]Lateral Branches – Branches born on the side of a structure or object (e.g., from lateral buds).

[2]Previous Year's Growth – Older segment stems in plants described by the growing season in which they were produced (e.g., 3-years ago).

[4]Ramet – An individual member of a clone.

[2]Retrogressed growth type – Architectural structure of a young plant caused by a change from light to intensive browsing. Terminal leaders on the plant do not get beyond the browse zone.

[2]Released growth type – Produced by a change from intensive to light browsing. Dominant stems develop from twig clusters.

[3]Stubble – The basal portion of herbaceous plants remaining after the top portion has been harvested either artificially or by grazing animals.

[4]Suckers – A shoot springing from the base of a tree or other plant, esp. one arising from the root below ground level as some distance from the main stem or trunk.

[2]Terminal Leader – The current year's growth at the tip of a primary stem. Trees typically have a single terminal leader, whereas shrubs typically have many.

[2]Uninterrupted growth type – Architectural structure of a young plant absent browsing or light browsing when terminal leaders are vulnerable. Each annual stem segment develops from the

terminal bud of the preceding year's stem segment. The plant shows potential to grow beyond the browse zone.

j. References

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